Identification and Follow-up of Clinical Pharmacokinetics Problems Using a Microcomputer-based Expert System to Scan Laboratory Drug Level Data

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Clinical pharmacokinetics evaluation and consultation can improve drug therapy and decrease the incidence of adverse drug reactions in selected patients, yet identification of these patients routinely in hospital or ambulatory patient populations has been difficult. We have developed a simple rule-based expert system that scans clinical laboratory drug level data for selected drugs to identify patients likely to benefit from follow-up. Rules for identifying drug level patterns indicating a need for follow-up were originally developed from a review of drug level data for digoxin, phenytoin, and theophylline (52 - 90 patients for each drug). Rules fell into 4 major categories: 1) sustained levels outside the therapeutic range, 2) sustained trends within the therapeutic range, 3) excessive variability between sequential values, and 4) inappropriate timing and frequency of drug level testing.

The expert system was implemented on an Apple Macintosh computer using Prograph, an object-oriented development environment with compiler. The software provides capabilities for user selection of specific drugs for scanning, user modification of data scanning rules, graphical review of data on-screen, limited pharmacokinetic analysis, and printing of graphical reports for charting or laboratory quality assurance studies. The system is designed to be appropriate for use by clinical or laboratory physicians, technical staff, or trainees.

Longitudinal drug level data for scanning is downloaded daily into the microcomputer from the laboratory information system as an ASCII file, and alert reports generated by the expert system are placed in identified patients' charts at the time of follow-up. In 90-day retrospective studies, the expert system flagged problem drug level patterns in monitored patients as follows:

	Flagged/total patients	Percent
Digoxin	36/170	21%
Phenytoin	10/76	13%
Theophylline	19/130	15%
Phenobarbital	9/80	11%
Valproic acid	4/39	10%
Procainamide	3/20	15%

Overall, 73% of identified patients showed multiple flagged specimens, with an average number of flagged specimens in these patients of 4.4. This system offers a means for focusing clinical pharmacokinetics resources on patients most likely to benefit from follow-up, and provides indicators likely to be useful in the quality management of drug therapy and drug monitoring.

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